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**Central Scientific
Computing Complex**

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NASA Langley Research Center

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**IMAGE PROCESSING MINI MANUAL
FOR THE
ANALYSIS AND COMPUTATION DIVISION'S
DATA VISUALIZATION AND ANIMATION LABORATORY**

June 1992

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GLOSSARY

ACD	Analysis and Computation Division, NASA Langley Research Center
central site	Facilities located in the 1268 building complex.
command driven interface	A user interface which accepts commands typed in at the keyboard. Such interfaces can function at the operating system level or through an interface program. The syntax can vary for different packages.
COSMIC	NASA's Computer Software Management and Information Center
CSCC	Central Scientific Computing Complex
DVAL	Data Visualization and Animation Laboratory
device independence	The ability to control all graphics devices uniformly.
FSGB	Flight Software and Graphics Branch of ACD
ftp	File Transfer Protocol. Also, a program which permits file transfers between computer systems.
host	Computer which provides processing support to other processors, workstations, or peripheral devices.
LaRCNET	Langley Research Center Network
LAN	Local Area Network
LaRC	Langley Research Center
man page	Reference manual pages accessible on-line via the man command.
menu driven interface	A user interface which accepts commands through a menu, often using a mouse to select input and options. The interface appearance and syntax can vary greatly for different packages.

metafile	A file which contains device-independent picture information necessary to produce the desired graphics.
metafile translator	The program which interprets the device-independent metafile commands for specific physical devices.
MSS	Mass Storage Subsystem
NCSA	National Center for Supercomputing Applications
NFS	Network File Server
OCO	Operations Control Office in Building 1268, 864-6562
OPEN LOOK	AT&T graphical user interface specification for the "look and feel" of a windowing environment.
OPEN WINDOWS	Sun Microsystem's implementation of OPEN LOOK.
PC	Personal Computer
pixel	The smallest unit available for display on a raster screen representing a single point in an image, often referred to as picture element.
pixel value	The value assigned to a pixel at a particular location.
PostScript	Page description language developed by Adobe Systems for outputting files to a printer.
production devices	Hardcopy graphics output facilities at the central site.
PVI	Precision Visuals, Inc. of Boulder, Colorado
redirection	The switching of program I/O from standard input/standard output to a file.
RM	Raster Metafile
RMT	Raster Metafile Translator
SNS	Supercomputing Network Subsystem
Standard input	In most cases, the user's terminal.
Standard output	In most cases, the user's terminal.

Sun	Sun Microsystems, Inc.
SunView	Sun's user-interface toolkit to support application packages executing within a window environment.
TAAC-1	Application accelerator board for the Sun workstation
Telnet	User interface to a remote system using the TELNET protocol
TCP/IP	Transport Control Protocol/Internal Protocol
UNIX	An operating system used on CONVEX's, CRAY's, and Sun workstations
video field	The tracks of information contained in 262.5 lines recorded during one pass from a video camera's vidicon tube. Two fields constitute a video frame.
video frame	Two passes from a video camera's vidicon tube recorded on video tape, or a complete 525 line picture.
VIPS	Video Image Processing System
WORM	Write once, read many
X	X Window System
X Window System	Network transparent window-based graphical user interface system
2D	Two-dimensional
3D	Three-dimensional
%	Unix prompt

1. INTRODUCTION

The purpose of this document is to describe the LaRC Central Scientific Computing Complex (CSCC) image processing capabilities. Since the Data Visualization and Animation Lab (DVAL) is the focal point for image processing at the CSCC, the document describes capabilities, both hardware and software, resident in and supported by the DVAL.

The document is divided into five major sections. Following this introduction, an overview of the DVAL is presented. Section three serves as a discussion on how to get started in the DVAL. The next section addresses how to bring image data into and out of the DVAL. Finally, section five describes the capabilities, features, and access information for individual software packages. A list of on-line documentation appears in Appendix A. A bibliography of related reference materials is provided in Appendix B.

This document is not intended to replace the documentation accompanying each software package or hardware component. It should serve to supplement other resources and direct the reader to them.

2. DATA VISUALIZATION AND ANIMATION LAB (DVAL) OVERVIEW

The Data Visualization and Animation Lab (DVAL) is an open shop facility created by and supported through the Flight Software and Graphics Branch of the Analysis and Computation Division to assist researchers with scientific visualization problems or requirements. The facility is housed within the CSCC, which is located in Building 1268. In addition to image processing, facilities are available to handle graphics and video animation requirements.

The image processing capabilities of the DVAL are supported primarily through a network of Sun workstations as shown in figure 1, and also through a network of Silicon Graphics Workstations as shown in figure 2. The steps involved in handling image processing requirements can be broken down into input, processing, and output.

Input is the means by which images are brought into the system. This can be accomplished in a variety of ways. Data in digital form, i.e., already existing in a computer file, may be transferred to the Sun network through Langley's local area network (LaRCNET), or may be brought in on 9-track magnetic tape. Hardcopy media in a form such as photographs, negatives, or x-rays can be digitized with either the Eikonix Model 1412 camera or the Sharp JX-650 flatbed scanner. Finally, a video input/output system is available through which video frames may be digitized for further processing.

Processing is accomplished through the use of a variety of software packages, described in Section 5 of this document. There are basically three styles of packages available. The first is the self-contained general purpose package, such as PV-WAVE or TAAC-1 software. In general, the features available in these packages must be accessed through an interface. The second is the toolkit package, such as ALV or HIPS. These packages are also general purpose, but the features are available as commands at the operating system level, and can be used independently of other components of the package. Thus, some features may be used as pre- or post-processing steps for other packages. The third is the program dedicated to a specific function, such as camtool for Eikonix camera operation (in one sense, each component of a toolkit package also belongs in this category). These packages have often been developed locally in response to the requirements of LaRC researchers. They include tools for image analysis, enhancement, registration, and the interactive analysis of interferometric fringe patterns.

Since the heart of the image processing capabilities in the DVAL is the Sun network, the predominant digital image format is the Sun rasterfile. Various utilities are available to facilitate the conversion both to and from the Sun format.

The functionality and characteristics of the various software packages available in the DVAL is shown in Table 1. Commercial software, public domain packages, and locally developed tools are available.

Output is also available in a variety of forms. Results of processing, data files or image files, may be sent to other systems using LaRCNET. Since the output from a lab session is most often a picture, many methods exist to obtain hardcopy. Within the lab, a Matrix film recorder is available to provide Polaroid hardcopy on-the-spot. Black-and-white laser and color printers are also available. The ACD production output devices may be accessed through the combination of translation software that converts the Sun rasterfile format to a format accepted by the production devices, and the local area network for porting the data to the devices. These include Versatec color printers, a color PostScript printer, and color film recorders. Video output capabilities are resident on the Video Image Processing System (VIPS) and the supported video formats include VHS, S-VHS, U-Matic, U-Matic SP, and Betacam.

For researchers requiring presentation quality videotape output, the Scientific Visualization System (SVS) is available. The Scientific Visualization System (SVS) is a state-of-the-art digital video editing suite for creating video reports of time dependent theoretical and experimental data. The system consists of a DF/X Composium video editor which controls digital video machines as well as analog video machines. The digital video machines include a SONY D1 tape recorder and an Abekas A60 real-time disk drive. Because these machines are digital video they preserve the integrity of the original images irregardless of the number of editing generations, so they are used as the primary editing sources and destinations. Also the Abekas is connected to the network so that digital images can easily be transferred from a workstation to the SVS. The analog machines include WORM laser disk recorders and numerous tape recorders (Betacam SP, S-VHS, and U-matic). These machines are used for input (e.g. a wind tunnel or in-flight experiment recorded onto video tape) and final output. One laser disk recorder is mounted into a transportable rack with a multiple frequency scan converter so that it can be shipped to the researcher's site and connected to a workstation/PC for local recording.

Finally, an audio system is being added to support narrations and background music.

3. GETTING STARTED IN THE DVAL

Since many techniques, particularly image enhancement, require the subjective opinion of the person who knows the data best, the DVAL was designed to provide an open shop, research environment in which researchers generally process and handle their own data. The staff are available to demonstrate the system capabilities and to consult with researchers on their specific image processing projects. Once the method of approach has been decided, the staff will provide instruction on the use of any equipment that is applicable to the project. If the project can be handled by existing software packages, the staff will provide the user with necessary documentation and training on usage of the package or packages. If minor modifications to existing software or major software development is needed to accomplish the project then any combination of the following is possible: the user, assisted by the staff, may write programs for the image processing system; the user may request contractor support for program development; and staff may provide the software.

An introductory session in the DVAL may be scheduled by contacting Kathy Stacy of the Flight Software and Graphics Branch, Analysis and Computation Division. The sessions last approximately 1 hour. It is appropriate to bring or have available a typical image to be processed. In this session, in addition to demonstration of capability, the best approach will be determined and software requirements will be discussed.

Each new user is asked to complete a DVAL Account Request Form prior to receiving a computer account on any of the DVAL workstations (see figure 3). Upon receipt of an Account Request Form with the appropriate authorizations, the System Administrator will establish the user account and contact the user with account information.

The DVAL workstations, located in room 1101 of Building 1268, are accessible on Langley's network through the LaRCNET terminal servers and via the rlogin and telnet commands from other computers. The hostids for these machines are available from the System Administrator.

The computing environment in the lab is UNIX based. On the Sun workstations, both the SunView and X Window System windowing systems are available.

An interactive on-line reservation facility is available through which individual

workstations or peripheral equipment may be reserved. Referred to as signup, this facility is described in Section 5.13.

Finally, as part of the ACD Customer Service program, an image processing help line is available by dialing x48533 or via electronic mail to iphelp@eagle. A special interest image processing mail group (ipsig@ipsun) is also available and utilized to communicate with other users, announce demonstrations, etc. Refer to Appendix C for information on participation.

4. HANDLING IMAGE DATA

This section addresses how to bring image data into and out of the DVAL, including data that is already in digital form, data to be digitized from some form of hardcopy, and data that was recorded on video tape. For digital data, Section 4.1 discusses the supported image format, conversion software, file transfers, and tape handling facilities. Section 4.2 addresses digitization when the source is a hardcopy. Finally, Section 4.3 outlines the video input capabilities of the DVAL.

4.1 Digital Data

4.1.1 Supported format

Since the DVAL image processing capabilities have been designed around Sun architecture, the supported image format is the Sun rasterfile. Most packages on the network support this format directly for both input and output. Conversion software is available through a number of packages that will handle conversion to/from the Sun rasterfile format. The file extension ".img" has been adopted as a local convention to indicate Sun rasterfiles. The UNIX file command (e.g., `file image_file_name`) can be used to check files in question. File will indicate "rasterfile" followed by the image dimensions if the file is a Sun rasterfile.

4.1.2 Conversion software

In general, while working within a package it is best to use the format native to the package (e.g., the TAAC application accelerator and the IFF format), and perform format conversions on input images and final results. Many packages can handle several formats, e.g., PV-WAVE can accommodate Sun rasterfiles, TIFF files, raw data files, and PostScript output. Refer to Section 5 for details about specific packages.

When format conversions are necessary, first check the package documentation to see if the conversion utilities are available. Other useful resources are the ALV package to convert raw 8-bit data files without header information to Sun rasterfile format and the PBMPPlus package, which is designed specifically to convert among many popular image formats.

4.1.3 Tape facilities

The Sun network is equipped with a 9-track magnetic tape drive capable of handling 1600 bpi or 6250 bpi. In addition, an 8mm Exabyte tape drive is available. The Exabyte drive is useful for storing large amounts of digital data, with a 2.3 gigabytes capacity. It is accessed through UNIX commands and since it is generally utilized for system backups, use of this device must be coordinated with the DVAL System Administrator.

The 9-track tape drive may be accessed through UNIX commands such as `mt` or `tar`, or may be controlled through software such as `tapetool`. Refer to Section 5.15 for additional information.

4.1.4 File transfers

The `ftp` user interface to the ARPANET standard File Transfer Protocol (FTP) is available on the Sun network to allow transfers to and from remote network sites. To obtain additional information on `ftp`, consult the man page by entering:

% man ftp

The host ids and numeric addresses for the machines on the Sun network are available from the DVAL System Administrator.

The LaRCNET Masstor commands are also available on the Sun network for the storage of large, infrequently used files. Refer to the Masstor man page:

% man masstor

4.2 Digitizing from hardcopy

The EIKONIX Model 1412 Digital Imaging Camera System is interfaced to a Sun 3/160 workstation for digitizing transparent film and opaque photographs, line art and three dimensional objects. Achromatic images require a single pass through the image, and result in 8-bit, 256 gray level output. A color filter wheel allows color scanning and requires three passes through the image using different color filters. Output resolutions up to 4096x4096 can be achieved. The available lenses include: 35mm, 55mm, and 105mm. A Gordon Instruments Transmissive/Reflective light table is used with the camera. Operating instructions are available for the light table in the DVAL. The software interface to the Eikonix camera is called `camtool`, and is discussed in Section 5.3.

4.3 Video Image Processing System (VIPS)

The Video Image Processing System provides an interactive capability for processing videotape images. The supported video formats include VHS, S-VHS, U-Matic, U-Matic SP, and Betacam. The digitization process produces 512x480 pixel images with 256 gray levels per pixel. Digitization occurs at the rate of 30 frames per second, and field accurate digitization from a specified time code is available.

A real-time digital disk allows video-rate storage of digital images, whether they are raw digital images from videotape or the results of video-rate processing. It allows playback of digital images at speeds up to and including video-rate. The disk has a 3.3 gigabyte formatted capacity, 6.9 minutes of real-time continuous capture, and a sustained data transfer rate of 9.8 MB/second.

This system also features selection and full operation of the VCR's from the Sun workstation, true color digitization in three passes, and a Sony Color Video printer for quick hardcopy. Non-video rate processing capabilities include morphological, analysis, frequency, and geometric functions. A software script mode allows recording and playback of a sequence of instructions.

Video-rate processing is available with the VIPS. The following operations are supported: arithmetic and logical operations between consecutive video frames, between a reference image and video frames, and regular and running averages; look-up table operations and interactive look-up table manipulation; look-up table transformations that include linear contrast stretch; and spatial convolutions with kernel sizes up to 8x8. These operations are supported by the Imaging Technologies, Inc. Series 150/151 Modular Image Processing Subsystem.

The software interface for the VIPS is a customized version of the Noesis Vision, Inc. VISILOG Image Processing Software (see Section 5.18). This capability is restricted to the Sun 3/260 workstation.

4.4 Image hardcopy capabilities

The DVAL is equipped with film recording equipment and black-and-white and color printers. The Matrix Instruments Model 6000 Color Graphic Recorder is connected to the Sun 3/280 workstation. It is capable of recording color or black and white photographic hardcopy from the analog video output of the Sun monitor. Interchangeable

backs are available that allow recording to 8"x10" or 4"x5" instant print and transparency film. A user's guide describing the operation of this device is available in the DVAL.

A Tektronix Phase II DX Model 4694 Color Image Printer is also available on the Sun network. The resolution of the printer is 300 dpi, and it is capable of producing either paper hardcopy or transparencies. The acquire program allows printing of screen regions from SunView or OPEN LOOK. While a man page is not available for acquire, the S-Print User Manual, available in the DVAL, documents program usage. The user may opt to print Sun rasterfiles directly by typing:

```
% lpr -v -PtcprSRF Sunfilename
```

The printer is located in the DVAL and output must be picked up there.

An Apple LaserWriter II is also available which accepts PostScript files. The lpr command uses this printer as the default. The following command will print a PostScript file:

```
% lpr -ps PostScriptfilename
```

5. PACKAGE DESCRIPTIONS

The following subsections describe the image processing and related utility packages available. The template shown here describes the organization of each subsection. Sample Sun rasterfile images are available on the Sun network under the /home/tipl/Images directory. Any file with the .img extension is suitable.

Purpose:

This section describes the purpose of the program or package, and the types of functions available.

Developed by:

This section indicates the source of the package. Possible sources include: locally developed, commercially available, or available through public domain sources.

Environment:

Describes the required environment for program execution. Possible environments include: SunView Window Environment, X Window System, or UNIX.

Restrictions:

Package specific restrictions, such as limitations to particular workstations due to licensing, hardware, or other constraints are noted here.

Image format:

The image formats supported by the package are noted in this section.

Documentation:

Information on how to access the appropriate manual pages and other forms of package documentation are described.

Path and environment variables:

If path or environment variables are required for program execution, they are noted in this section.

Invoke:

The UNIX command which invokes the package is noted here.

Image display:

A specific example of how images are displayed in the package, subject to previously noted restrictions is shown.

Exit:

The method for exiting the package is demonstrated here. If a package consists of commands executed from the UNIX shell prompt, then no explicit commands are necessary. However, the user is expected to know how to close and/or kill any windows the package may create.

5.1 ALV Public Domain Image Processing Toolkit

Purpose:

The ALV toolkit is a collection of image processing programs designed for use on Sun workstations. The programs provide general manipulation and display of images on color or black and white workstations.

Following are brief descriptions of the individual Alv programs:

- and - combine binary rasters
- array2ras - convert array to raster
- blend - blend two rasters together
- box - box a raster
- center or centre - center a raster in a larger area
- convert - convert textual raster to raster
- convolve - convolve a raster with a linear integer filter
- cst - interactive contrast stretching of a raster
- dither - convert 8 bit raster to 1 bit using dither matrix
- double - double the size of a raster
- dsp - display a raster on screen
- equalise - equalize a raster
- fconvolve - convolve a raster with a linear non-integer filter
- ffill - flood fill a raster
- frame - frame a raster
- glass - interactive on-screen zooming
- half - halve the size of a raster
- halftone - convert an 8 bit raster to 1 bit using bitmap font
- hist - display histogram of raster
- hough - perform Hough transform
- im2ras - convert old ALV format to raster
- invert - invert the pixels in a raster
- offset - translation offset of a raster
- or - or binary rasters
- palettetool - interactive colormap editor

quad - quadruple the size of a raster
quarter - quarter the size of a raster
ras2array - convert raster to array
ras2im - convert raster to old ALV format
ras2lw - output a raster on a Laserwriter
ras8to1 - perform various diffusion/dither algorithms
rasbrowse - browse a number of rasters and make movies
rasinfo - print raster dimensions and depth
rasrange - range a raster's greylevels
rasregion - clip a raster to a region
rasremap - LUT modification of a raster
rasscale - scale a raster's size by a scale factor
rasthresh - threshold raster
rasval - print pixel values of raster
scr2ras - interactive screendump to raster
scrload - screenload
third - third the size of a raster
transform - shear or rotate a raster
triple - triple the size of a raster
winlev - convert N bit deep raster to 8 bits deep displayed raster
xor - xor rasters

Developed by:

The ALV Image Processing Toolkit for Sun Workstations (Version 2.0.9) was developed by Phill Everson of the University of Bristol, United Kingdom. Source code is also available and is located in the directory /usr/local/Alv/src on the Sun network.

Environment:

The individual programs in the toolkit communicate with each other via intermediate files or UNIX pipes and the Sun rasterfile format. A consistent convention for command line arguments is provided in all of the programs. An input file can be read on the standard input stream, and an output file can be written to the standard output

stream. Other conventions are described in the on-line documentation.

The programs which display a result must be run in the SunView or OpenWindows windowing environments. Other commands may be executed remotely.

Restrictions:

There are no known restrictions.

Image Format:

Sun rasterfile

Documentation:

The ALV documentation is available in the directory `/usr/local/Alv/doc` on the Sun network. The README file in this directory describes how to view the documentation on the screen or route it to a printer. To view the documentation on the screen from the directory `/usr/local/Alv/doc`, invoke the `alv-docs` command as shown here:

```
% alv-docs | more
```

To display the manual page for the ALV toolkit, the following command may be entered:

```
% man alv
```

Individual man pages are also available for most of the ALV commands. To obtain information on the program `array2ras`, for example, enter the command:

```
% man array2ras
```

Path and Environment Variables:

For information on customizing ALV, enter the following command:

```
% man alv_profile
```

Invoke:

The means for invoking each ALV command and the command line arguments for that command are described in the individual manual pages for each command. In general, if the program requires an input file, it can be read from the standard input stream. Likewise, if the program produces an output file, it may be written to the standard output

stream. For example, to convert a 512x512x8 byte formatted image to a Sun rasterfile and display the result in a SunView or OpenWindows window, the `array2ras` and `dsp` programs would be invoked as follows:

```
% array2ras filename | dsp
```

Image Display:

In the SunView or OpenWindows environment, the command

```
% dsp Sunfilename
```

will display the Sun rasterfile `Sunfilename` on the Sun screen.

Exit:

For the ALV commands that pop-up a SunView window, the window may be dismissed in the following way. Move the mouse cursor to the namestripe across the top of the window. The cursor should become a circle target. Depress the right mouse button and hold it down to pop up the frame menu. Choose the quit option by dragging the cursor into the Quit menu item rectangle. Release the mouse button.

Commands that do not rely on a window display will terminate upon successful completion of the command.

5.2 Blobtool

Purpose:

Blobtool is an image analysis program used to generate quantitative measurements. Since the measurements are derived from binary images, five thresholding methods are provided which generate a binary image from a grayscale image. The thresholding techniques are: User supplied, Otsu, entropic, minimum error, and moment preservation.

After a binary image has been produced, objects within the image are detected through use of 4-, 6-, or 8-connected neighborhoods. The measurements reported for each object include: Area, perimeter, Euler number, center x, center y, minimum or maximum radius, maximum radius/minimum radius, compactness, orientation, eccentricity, 2nd moment about vertical or horizontal line through center, XY moment about the center, 1st moment about x- or y-axis, 2nd moment about x- or y- axis, XY moment about the origin, X and Y location of each perimeter point, and X and Y location of each pixel in the object.

Other options are available to provide basic I/O capabilities, color table manipulations, and single image statistics. A detailed description of the features and options are available through the help option, accessible while executing this package.

Developed by:

This package was developed by Computer Sciences Corporation for LaRC. The source code is available on the Sun network under /usr/local/blobtool or through COSMIC software distribution.

Environment:

SunView or Open Windows

Restrictions:

The maximum size image that can be displayed within this package is restricted to 4,892,944 bytes. Image files must have the ".img" extension.

Image format:

Sun rasterfile

Documentation:

A man page for this package is available and may be viewed by typing:

% man blobtool

NASA Contractor Report 4420, "Analysis of Objects in Binary Images" describes the package as well as the investigation and selection of various techniques.

Path and environment variables:

None

Invoke:

% blobtool

Image display:

The Load Image >> button enables the user to read a Sun rasterfile and display it. The file's name is a concatenation of the names entered on the Directory and File item entries in the instruction panel region. Image files must have the file extension ".img".

Exit:

Click the left mouse button on the Quit button in the instruction panel.

5.3 Camtool

Purpose:

Camtool provides a graphical user interface for the Eikonix Model 1412 digitizing camera system. Users may digitize from several different mediums and select from three digitization destinations: workstation display screen, magnetic tape drive, or hard disk. It allows researchers to initiate camera system support options and modify parameters affecting the digitization process, such as the illumination source, the exposure level of the diodes to the illumination source, the camera lenses, the color filters, and the height to which the camera is set. A variety of image types may be scanned, including: monochrome or color, halftones, reflectives, transmissives, rigid or flexible material, or three dimensional objects. It is possible to scan and digitize any combination of resolutions with a maximum of 4096 x 4096 resolution. Although the camera is capable of digitizing in 8-bit or 12-bit format, the package currently supports 8-bit data.

In addition, other options are available which provide I/O capabilities, color table enhancements, and single image statistics. A detailed description of the features and options are available through the help option accessible while executing this package.

Developed by:

This package was developed by Computer Sciences Corporation for LaRC. The source code is available under /usr/local/camtool on the Sun network or through COSMIC software distribution.

Environment:

SunView or Open Windows

Restrictions:

Digitization of 12-bit image data and true color digitization are not implemented. The maximum size image that can be displayed in a SunView window is 4,892,944 bytes. The Scan to Tape option writes the image to tape using 6250 bpi density. Image files must have the ".img" extension. The package must be executed on the Sun 3/160 which interfaces to the camera.

Image Format:

Sun rasterfile

Documentation:

The man page for this package may be viewed by typing:

% man camtool

The operation of the camera and the options and features of this package are described in an on-line help file accessible through the Help option. The Camtool Version 2.0 User's Guide is also available. The EIKONIX Model 1412 Digital Imaging Camera System Operator's Guide contains information about the camera's hardware and software and is available for use in the DVAL.

Path and Environment variables:

None

Invoke:

% camtool

Image Display:

Images are displayed by invoking the Scan to Screen or the Load Image >> options. The Scan to Screen option interfaces with the camera. It digitizes the object/scene located on the light table and displays the scene in the appropriate window. The Load Image >> button enables the user to read a Sun rasterfile and display it. The disk file's name is a concatenation of the names entered with the Directory and File items in the instruction panel region.

Exit:

Click the left mouse button on the Quit button in the instruction panel.

5.4 Dumpregion

Purpose:

Dumpregion is a software package distributed through the Sun User's Group that allows the user to select a region of a Sun screen and dump it to a file in Sun rasterfile format.

Developed by:

The software was written by Richard Tobin, Edinburgh University and obtained from the Sun User's Group distribution tape.

Environment:

SunView or Open Windows

Restrictions:

None

Image format:

Sun rasterfile

Documentation:

A man page for this package is available and may be viewed by typing:
% man dumpregion

Path and environment variables:

None

Invoke:

% dumpregion > Sunfilename

A cursor will appear on the screen which defines one corner of the rectangular region to be dumped. To fix the opposite corner, depress the left mouse button and drag the cursor to the desired position.

Image display:

Not applicable

Exit:

The package will terminate when generation of the output has completed.

5.5 Enhancetool

Purpose:

Enhancetool is a SunView based package for performing image enhancement and lookup table modifications on Sun rasterfiles. Currently, the following enhancement techniques are available:

- Local Transformations
 - Local range modification
- Global Transformations
 - Automatic linear contrast stretch
 - Linear contrast stretch
 - Logarithmic
 - Square root
 - Digital negative
 - Intensity level slicing
- Histogram Modification
 - Histogram equalization
 - Histogram specification

In addition, distance and angle measurements may be obtained within the package.

Developed by:

This software was developed by Computer Sciences Corporation for LaRC. The source code is available on the Sun network in /usr/local/enhancetool. It is also distributed through COSMIC.

Environment:

SunView or Open Windows

Restrictions:

Image files must have the ".img" file extension.

Image format:

Sun rasterfile

Documentation:

A detailed explanation of the features and operations of the package is located in the file /usr/local/enhancetool/Docu/enhancetool_help.txt. The reader may access this file using the more command at the shell level or through the Help option while executing Enhancetool.

A man page is available for this package and may be viewed by entering:

% man enhancetool

Path and environment variables:

None

Invoke:

% enhancetool

Image display:

The Load Image >> button enables the user to read a Sun rasterfile and display it. The disk file's name is a concatenation of the names entered with the Directory and File items in the instruction panel region.

Exit:

Click the left mouse button on the Quit button in the instruction panel.

5.6 HIPS (Human Information Processing Software)

Purpose:

HIPS is an image processing software package. Many commands have been added by other contributors and the original software has had extensions to its basic capabilities. The types of functions available are:

1. Simple operations on images, including

Image statistics	Histograms
Enlargement/reduction	Reflecting/rotating
Pixel manipulation	Noise generation
Frame arithmetic on sequences	
2. Filters, convolutions and transformations of images

Linear/nonlinear filters	Edge detection
Pyramid processing	
3. Simulation schemes for image transmission

Noise elimination	Compression
-------------------	-------------
4. Generating 3-D line drawing sequences
5. Housekeeping functions such as format conversion and header access.
6. User contributed routines

Extract low level features	Compute shape descriptors
Process stereograms	Compute Hough transforms
Smooth by multifiltering	Morphological operations
Modify Look Up Tables(LUT)	Histogram image sequences
Process RGB images	Classify objects
Warp images	

Developed by:

HIPS Picture Processing Software is commercially available from:

Sharp Image Software
P.O. Box 373
Pine Street Station
New York, NY 10012-0007
(212) 998-7857

Most of the programs were written by Michael Landy and Yoav Cohen.

Environment:

The package is command driven, so all commands except image display commands may be issued from the UNIX prompt. Image display is available for the SunView, Open Windows, and X Window System environments.

Restrictions:

If HIPS source code is used elsewhere, the author must be credited.

Image format:

The format supported is the HIPS image format. To obtain additional information on the HIPS image format, enter the command:

% nroff -me /usr/local/hips/hips/doc/hipl_format.me | more

An extensive list of format conversion programs are available. To convert a Sun rasterfile to HIPS format:

% suntohips < Sunfilename > Hipsfilename

To convert a HIPS image to a Sun rasterfile:

% hipstosun < Hipsfilename > Sunfilename

Documentation:

A complete list of HIPS commands, arranged by functional category, is available in the hips(l) man page. In addition, each HIPS command has its own manual page. The following documentation is available in the DVAL:

Cohen and Landy, HIPS Picture Processing Software

Cohen, PLOT-3D: A Software Package for Generating and Manipulating
3D Graphs

Cohen and Landy, The HIPS Picture Processing Software Reference Manual

Landy, HIPS Picture/Header Format Standard

Path and environment variables:

If running under the X Window System, the DISPLAY environment variable should be set as follows:

```
% setenv DISPLAY WorkstationName:0.0
```

Invoke:

It is necessary to use redirection of input and output when invoking HIPS commands and the flexibility of piping to other commands can be used. To invoke a HIPS command(s):

```
% hipscmd < infile > outfile
```

```
% hipscmd_1 < infile | hipscmd_2 | ... | hipscmd_N > outfile
```

Image display:

To display a HIPS image in SunView:

```
% sunv < Hipsfilename
```

To display a HIPS image in X Windows:

```
% xhips < Hipsfilename
```

Exit:

For the HIPS commands that pop-up a SunView window, the window may be dismissed in the following way. Move the mouse cursor to the namestripe across the top of the window. The cursor should become a circle target. Depress the right mouse button and hold it down to pop up the frame menu. Choose the quit option by dragging the cursor into the Quit menu item rectangle. Release the mouse button.

Commands that do not rely on a window display will terminate upon successful completion of the command.

5.7 Mathematica

Purpose:

Mathematica is a general system for performing mathematical computation. Mathematica can perform numeric, symbolic and algebraic operations and can generate both two and three dimensional graphics.

Developed by:

Wolfram Research, Inc.

Environment:

X Window System

Restrictions:

Must be executed on the workstation with the software license, but may be run remotely under X Windows.

Image Format:

Image data may consist of byte or real binary data, as well as ascii numbers.

Documentation:

A man page is accessible by entering the command:

```
% man math
```

S. Wolfram, Mathematica, A System for Doing Mathematics by Computer, Addison-Wesley, 1988.

Path and Environment Variables:

If running remotely under the X Window System, the DISPLAY environment variable should be set on the client as follows:

```
% setenv DISPLAY WorkstationName:0.0
```

Invoke:

% math

Image Display:

To read in an image consisting of byte data:

```
In[1]:= ReadList["filename", Byte];  
In[2]:= Partition[%, number_of_columns];  
In[3]:= Reverse[%];  
In[4]:= ListDensityPlot[%, Mesh -> False]
```

To skip over a header n bytes in length, type:

Drop[%, n] following the ReadList command

Exit:

To exit the package, type Quit at the In[5] prompt:

```
In[5]:= Quit
```

5.8 NCSA Imagetool

Purpose:

Imagetool is a window driven package that provides a variety of methods for visualizing a set of data points. Color images, contour plots, 3D plots, and XY graphs are mechanisms to view the data. Images can be magnified, composited, and edited. Color palettes can be modified and saved. Images may be stacked to produce animation sequences.

Developed by:

Imagetool is a public domain software package from the National Center for Supercomputing Applications (NCSA) developed by Dr. Michael L. Norman and Carol Song at the University of Illinois at Urbana-Champaign.

Environment:

SunView or Open Windows

Restrictions:

None

Image format:

The image formats supported include raw data files (8-bit byte and floating point), and Sun rasterfile.

Documentation:

On-line help may be obtained from within Imagetool by selecting the help button with the left mouse button. The help files are located on-line in the directory `/usr/local/imagetool/help` and may be viewed by entering:

% more /usr/local/imagetool/help

A document called ImageTool for the Sun Workstation Version 1.0 is also available. The troff files for this document are located under `/usr/local/imagetool/doc`. The Makefile in that directory demonstrates how to print the document.

Path and environment variables:

The .imagetool-defaults file contains defaults for images directory, palette file, and help directory.

Invoke:

% Imagetool

Image display:

To load an image, specify the name of the file and the dimensions. Position the cursor over the Image button, and depress the right mouse button to display the options. Keep the right button depressed, and move the mouse to Load and select the correct format. To change the current directory, enter the directory name and click on the Directory item with the right mouse button to select Change directory.

Exit:

Click the left mouse button on the Quit button in the instruction panel.

5.9 PBMPlus - Extended Portable Bitmap Toolkit

Purpose:

PBMPlus is a suite of 75 commands and libraries of subroutines for converting between various image formats. The package consists of four groups of commands:

- PBM - for 1 bit per pixel bitmaps
- PGM - for grayscale images
- PPM - for full-color images
- PNM - manipulations on the other 3 formats

Developed by:

The software was developed by Jef Poskanzer and is available through public domain sources or on the Sun network in /usr/local/pbmplus.

Environment:

UNIX command line

Restrictions:

None

Image format:

The formats supported are identified here and are documented in the on-line file /usr/local/pbmplus/FORMATS:

PBM:

Sun icon file	reading writing
X10 and X11 bitmap file	reading writing
MacPaint	reading writing
CMU window manager format	reading writing
MGR format	reading writing
Group 3 FAX	reading writing
GEM .img format	reading writing

Bennet Yee's "face" format	reading writing
Atari Degas .pi3 format	reading writing
Andrew Toolkit raster object	reading writing
Xerox doodle brushes	reading
ASCII graphics	writing
HP LaserJet format	writing
GraphOn graphics	writing
BBN BitGraph graphics	writing
Printronic format	writing
Gemini 10x printer format	writing
Epson printer format	writing
UNIX plot(5) file	writing
Zinc Interface Library icon	writing
PGM:	
Usenix FaceSaver(tm) file	reading writing
FITS	reading writing
Lisp Machine bit-array-file	reading writing
raw grayscale bytes	reading
HIPS	reading
PostScript "image" data	reading
PPM:	
GIF	reading writing
IFF ILBM	reading writing
PICT	reading writing
Atari Degas .pi1 format	reading writing
XPM (X Window System ASCII pixmaps)	reading writing
PC Paintbrush .pcx format	reading writing
TrueVision Targa file	reading writing
HP PaintJet format	reading writing
Abekas YUV format	reading writing
MTV/PRT ray-tracer output	reading
QRT ray-tracer output	reading

Img-whatnot file	reading
Xim file	reading
Atari uncompressed Spectrum	reading
Atari compressed Spectrum	reading
NCSA Interactive Color Raster	writing
X11 "puzzle" file	writing
Motif UIL icon file	writing
DEC sixel format	writing
PNM:	
Sun raster file	reading writing
TIFF	reading writing
X11 window dump file	reading writing
X10 window dump file	reading
PostScript	writing

Documentation:

The README file in /usr/local/pbmplus contains valuable information about the PBMPlus software.

Path and environment variables:

None

Invoke:

The individual programs in the toolkit communicate with each other via UNIX pipes. A consistent convention for command line arguments is provided in all of the programs. An input file can be read on the standard input stream, and an output file can be written to the standard output stream. Other command line arguments are as described in the man page for each individual command.

To illustrate how the PBMPlus programs work, the following example is provided. Assume that the user wishes to convert a color Sun rasterfile called SunFilename to a color Encapsulated PostScript file. This could be accomplished as follows:

```
% rasttopnm Sunfilename | pnmtops > PostScriptfilename
```

A list of the PBMPlus programs follows. To obtain information on an individual program, refer to the man page for that command.

anytopnm	pbmreduce	pbmtozinc	pnmcats	pnmtotiff	ppmtouil
atktopbm	pbmtext	pbmupc	pnmconvol	pnmtowd	ppmtoxpm
brushtopbm	pbmto10x	pcxtoppm	pnmcrop	ppmdither	ppmtoyuv
cmuwmktopbm	pbmtoascii	pgmbentley	pnmcut	ppmhists	psidtopgm
fitstopgm	pbmtoatk	pgmedge	pnmdepth	ppmmake	qrttoppm
fstopgm	pbmtobnbg	pgmenhance	pnmenlarge	ppmpat	rasttopnm
g3topbm	pbmtocmuwm	pgmhists	pnmfile	ppmquant	rawtopgm
gemtopbm	pbmtoepson	pgmnorm	pnmflip	ppmquantall	rawtoppm
giftoppm	pbmtog3	pgmoil	pnmgamma	ppmrelief	rgb3toppm
gouldtoppm	pbmtogem	pgmramp	pnmindex	ppmtogif	spctoppm
hipstopgm	pbmtogo	pgmtexture	pnminvert	ppmtoicr	sputoppm
icontopbm	pbmtoicon	pgmtofits	pnmmargin	ppmtoilbm	tgatoppm
ilbmtoppm	pbmtolj	pgmtofs	pnmnoraw	ppmtopcx	tifftopnm
imgtoppm	pbmtomacp	pgmtolispm	pnmpaste	ppmtopgm	xbmtopbm
lispmtopgm	pbmtomgr	pgmtopbm	pnmrotate	ppmtopi1	ximtoppm
macptopbm	pbmtopi3	pgmtoppm	pnmscale	ppmtopict	xpmtoppm
mgrtopbm	pbmtoplot	pi1toppm	pnmshear	ppmtopj	xwdtopnm
mtvtoppm	pbmtoptx	pi3topbm	pnmsmooth	ppmtopuzz	ybmtopbm
pbmlife	pbmtox10bm	picttoppm	pnmtile	ppmtorgb3	yuvtoppm
pbmmake	pbmtoxbm	pjtoppm	pnmtops	ppmtosixel	
pbmmask	pbmtoybm	pnmarith	pnmtorast	ppmtotga	

Image display:

Not available with this package.

Exit:

The individual programs terminate after completion of the conversion.

5.10 PV~WAVE

Purpose:

PV~WAVE is the Precision Visuals Inc. Workstation Analysis and Visualization Software Environment. It provides 2D, 3D, and 4D data display, image processing, data analysis, data visualization, data reduction and filtering, and signal processing. It may be used interactively, and is programmable.

Developed by:

Precision Visuals Inc.
6260 Lookout Rd.
Boulder, Colorado 80301

Environment:

SunView, Open Windows, X Window System

Restrictions:

Use of this package is restricted by a software licensing mechanism.

Image format:

Directly supports Sun rasterfile, TIFF, PostScript. Programmable features may be used to read other formats.

Documentation:

The man page may be viewed by typing:

% man wave

The PV~WAVE Technical Reference Manual is available for use in the DVAL. In addition, PV~WAVE has an on-line help facility. On the Sun workstations, this may be accessed by depressing the R2 key at the WAVE> command prompt. Within the X Window System, on-line help may be obtained by entering a ? at the WAVE> command prompt.

Path and environment variables:

Several environment variables are used by the PV~WAVE software. These are described in the man page.

Invoke:

% wave

Image display:

A Sun rasterfile may be read into PV~WAVE with the command:

read_srf,'Sunfilename',image

To open a window in which to display a 512 x 512 image, use the command:

window,/free,xsize=512,ysize=512

Finally, the image may be displayed in the window with the command:

tv,image

Exit:

To exit the package, type exit at the WAVE> prompt.

5.11 Registertool

Purpose:

The purpose of this package is to allow a user to interactively register spatially similar images. Two sets of corresponding points (tie points) are chosen in the original and reference images to determine the rotation, translation, and scaling of the original image with respect to the reference image. Since it is important that the points be chosen with accuracy, a zoomed area of both images is displayed to allow the user to choose a particular point with greater precision. The registered image can be saved to disk.

Developed by:

This software was developed by Computer Sciences Corporation for LaRC. The source code is available on the Sun network in /usr/local/registertool. It is also distributed through COSMIC.

Environment:

SunView or Open Windows

Restrictions:

Image files must have the ".img" file extension.

Image format:

Sun rasterfile

Documentation:

A detailed explanation of the features and operations of Registertool is located in the /usr/local/registertool/Docu/registertool_help.txt file. The reader may access this file using the more command at the shell level or by invoking the Help option within the package. The man page may be viewed by typing:

% man registertool

Path and environment variables:

None

Invoke:

% registertool

Image display:

The Load Image >> button enables the user to read a Sun rasterfile and display it. The disk file's name is a concatenation of the names entered with the Directory and File items in the instruction panel region.

Exit:

Click the left mouse button on the Quit button in the instruction panel.

5.12 Rmtran

Purpose:

The Raster Metafile Translator (RMT) is a command-driven interpreter capable of processing RM images and performing image conversion and manipulation. Images may be composited, clipped, resized, or displayed, and a variety of conversions are available. In addition to the RM format, other supported formats include:

- Celco color film recorder

- AED 767

- Dicomed D47 color film recorder

- PostScript laser printer

- Color PostScript laser printer (for intensity and color table images)

- SCODL (binary format)

- Sun rasterfile

- Targa 24 (RGB unmapped format)

- Tektronix 4109

- Tektronix 4125

- Versatec color electrostatic plotter

- Versatec color thermal plotter (A and B size)

Developed by:

Rmtran was developed at LaRC by Computer Sciences Corporation. Source code is available on the SNS machines.

Environment:

- UNIX command line

Restrictions:

The F77 compiler must be available to build the RMTRAN executable.

Image format:

The Raster Metafile (RM) format is a generic raster image format developed by LaRC. The format is described in CSCC document G-14.

Path and environment variables:

It is necessary to set two environment variables, RMTERR and RMTHELP as described in the man page.

Documentation:

Help may be obtained from within the package by entering the help command. Further information on the individual commands in the RMT is available in the on-line help file /usr/local/rmtran/HELP.DOC and in the referenced CSCC document. Detailed access information and sample terminal sessions for Rmtran are also described in the document. The man page may be viewed by entering the command:

% man rmtran

Invoke:

The rmtran script links the RMT with a user specified device driver and executes the RMT. A list of device names is available in the rmtran man page. To link the RMT with the PostScript device driver and execute, the following command would be entered:

% rmtran postscript

Image display:

Not applicable

Exit:

Enter quit or q at the prompt.

5.13 Signup

Purpose:

Signup is an interactive program that serves as a reservation system for the equipment and workstations.

Developed by:

The signup program was developed at LaRC. Source code is available on the Sun network in /usr/local/signup.

Environment:

Signup may be run from any terminal and is not dependent on a windowing environment. It relies on the curses package for terminal independent I/O.

Restrictions:

The screen must be 24 lines long and 80 columns wide.

Image format:

Not applicable

Documentation:

Additional information on this program may be obtained by entering:

% man signup

Path and environment variables:

None

Invoke:

% signup

Image display:

Not applicable

Exit:

The signup program is exited with the exit menu selections within the package.

5.14 TAAC Application Accelerator

Purpose:

The TAAC-1 application accelerator is a powerful, user programmable accelerator useful for computation intensive image processing applications. The TAAC ip demo provides a means of accessing many preprogrammed image processing operations and performing compute intensive processing quickly and easily. Arithmetic functions, logic operations, spatial and frequency domain filtering capabilities, morphological processing, and image remapping are available. A variety of fast, interactive processing capabilities including image zooming, Fourier processing, warping, histogram plotting, look up table modification and image profiling are also offered. The TAAC provides the capability to display and process 24 bit color images, however processing capabilities in the demo are limited to images no larger than 512x512 pixels. Larger images, up to 1024x1024 pixels, may be accommodated by programming the TAAC.

Developed by:

Sun Microsystems, Inc.

Environment:

SunView

Restrictions:

Must be run on the Sun 3/280 workstation interfaced with the TAAC-1 accelerator board.

Image Format:

IFF file format (this is different from AMIGA IFF format) is the supported format. Utilities are available to convert from Sun rasterfile to IFF and from IFF to Sun rasterfile.

Documentation:

The TAAC-1 Application Accelerator: User's Guide is available in the DVAL.

Path and Environment Variables:

```
% setenv TAAC1 /usr/local/taac
% set path = ($path $TAAC1/bin $TAAC1/demo/bin)
% set path = ($path $TAAC1/diags/bin)
```

Invoke:

```
% tademo and click on <ip demo> icon
```

Image Display:

Before invoking the package, load an image into TAAC memory.

For an 8-bit Sun rasterfile

```
% ras2taac [-n] [-x xoffset] [-y yoffset] Sunfilename
```

(The default xoffset, yoffset is 0,0 and loads the image into the first 512x512 page of the image buffer.)

For a 24-bit Sun rasterfile image:

```
% mrgcoloras RedSunfilename GreenSunfilename
BlueSunfilename rasterfilename
```

```
% ras2taac [-n] [-x xoffset] [-y yoffset] rasterfilename
```

To read the result back out and produce a Sun rasterfile:

For 8-bit image data:

```
% tared [-x xoffset] [-y yoffset] | iff reorder -b 3 | iffstrip |
array2ras > Sunfilename
```

For 24-bit image data:

```
% tared [-x xoffset] [-y yoffset] | iff reorder -b 3 | iffstrip |
array2ras > RedSunfilename
% tared [-x xoffset] [-y yoffset] | iff reorder -b 2 | iffstrip |
```

```
array2ras > GreenSunfilename  
% tared [-x xoffset] [-y yoffset] | iff reorder -b 1 | iff strip |  
array2ras > BlueSunfilename
```

To determine the xoffset and yoffset values to be used for a result image out of the TAAC, quit the ip demo and click on the image icon. Cycle through the TAAC pages by clicking on the page cycle indicator. Image memory is divided into eight 512x512 pages; page 1 starts at xoffset, yoffset (0,0), page 8 starts at (512,1536), etc.

Exit:

Click the left mouse button on the exit button in the panel. To exit the tademo, move the mouse cursor to the namestripe across the top of the window. The cursor should show a circle target. Depress the right mouse button and hold it down to pop up the frame menu. Choose the quit option by dragging the cursor into the Quit Menu item rectangle. Release the mouse button.

5.15 Tapetool

Purpose:

The Tapetool program allows users to transfer images from disk and/or the screen to tape, and from tape to disk and/or the screen. The program allows software control of the 9-track magnetic tape drive for operations such as find load point, find end-of-medium, forward and backspacing of files, etc.

Developed by:

This program was developed by Computer Sciences Corporation for LaRC. The source code is available on the DVAL Sun network.

Environment:

SunView or Open Windows

Restrictions:

The maximum image size supported by this program when reading from tape to the screen display is 2048 x 2048. Image files must have the ".img" file extension and it is necessary to have a directory called Images for files to be written to/read from.

Image format:

Tape data is stored as 8-bit byte data with no header information. Images read from tape are converted to Sun rasterfile format prior to being stored on disk.

Documentation:

There is no supporting documentation for this package.

Path and environment variables:

None

Invoke:

% tape16 for 1600 bpi tape density

<or>

% tape62 for 6250 bpi tape density

Image display:

Images are displayed by invoking the Tape to Screen or Disk to Screen options. The Tape to Screen option interfaces with the tape drive and reads an image from tape, displaying it in the desired window. The Disk to Screen option enables a Sun rasterfile to be read and displayed. The disk file's name is a concatenation of the names entered with the Directory and File items in the instruction panel region.

Exit:

Click the left mouse button on the Quit button in the instruction panel.

5.16 TECPLOT

Purpose:

TECPLOT is an interactive program for visualizing engineering and scientific data. It integrates XY plotting, two-dimensional, and three-dimensional plotting capabilities.

Developed by:

AMTEC Engineering, Inc.
Bellevue, WA
(206) 827-3404

Contact John T. Bowen at x46725 for more information.

Environment:

SunView and X Window System

Restrictions:

The ras2tec filter works for images smaller than 128x128. Use rasscale or rasregion to reduce the size of a larger image.

Image Format:

TECPLOT processes binary data files, which may be prepared in an ASCII format (described in the TECPLOT documentation) and preprocessed with the utility program PREPLOT. PREPLOT can also handle PLOT3D format data files. To prepare a Sun rasterfile image for PREPLOT, use the ras2tec filter.

Documentation:

CSCC Document G-19a:TECPLOT Version 5 USER'S MANUAL.

Path and Environment variables:

If running under the X Window System, the DISPLAY environment variable should be set as follows:

% setenv DISPLAY WorkstationName:0.0

Invoke:

% tecplot (for Sunview)
% xtecplot (for X windows)

Image Display:

The following example illustrates how to display a Sun rasterfile. To display other varieties of TECPLOT input files, refer to the documentation. The style of the example follows the style used in Chapter 15 - Tutorial of the User's Manual.

```
% ras2tec yourfile.img yourfile.dat  
% preplot yourfile.dat yourfile.plt  
% tecplot
```

The following commands are selected within the TECPLOT environment:

File	Read in the data file yourfile.plt
DataFiles	
Read	
yourfile.plt <return>	
Contour	
<Use mouse or arrows>	Use arrow keys or the mouse to highlight the third variable called "inten"
<return>	Press the return key; contour lines of the image will be displayed. Proceed to the next step to cancel the contouring (or skip the next step if the contour completes) to display an intensity image.
<esc>	Abort the contour; it may take several seconds before the contour operation is aborted.
Options	Select the Options/Colormap menu to turn on grayscale.
ColorMap	
Reset	
GrayScale	

<esc> Escape up to the Contour menu.

<esc>

<esc>

Zones Select the Options/Zones menu to turn on floodfill.

PlotType

Flood

<return> Assign all zones (only one zone exists).

<esc> Escape up to the Contour menu.

<esc>

Regen

Exit:

Select the Files option.

Select the Quit option.

type q <return>

5.17 Touchup

Purpose:

Touchup is a bitmap graphics editor for the Sun workstation which can be used to edit Sun rasterfiles. The following summarizes the functions available in Touchup:

- Paint with different textures
- Draw various graphical entities such as circles, rectangles, ovals, lines, and polygons
- Examine and modify a region at magnification 1-20
- Use text in many fonts
- Flood fill an area with a pattern
- Lasso a free form region within a bitmap
- Scale-stretch a region of a bitmap
- Rotate a region
- Move a region

Developed by:

Ray Kreisel
Computer Science Department
SUNY at Stony Brook
Stony Brook NY 11794

Source code for this package is available on the Sun network in the directory `/usr/local/touchup/src`. Other related files are located in `/usr/local/touchup`.

Environment:

SunView or Open Windows

Restrictions:

This package runs very slowly on Suns with less than 16 megabytes of main memory. Increased performance can be achieved by disabling the "undo" feature when invoking Touchup.

Image format:

Sun rasterfile

Documentation:

To display the man page, enter the command:

% man touchup

To obtain help while in the package, depress the left mouse button with the cursor positioned on the View button. A window containing the manual page will be displayed. The help window is exited by depressing the left mouse button on the Done button in the help window. Additional information on Touchup is available on-line in the file /usr/local/touchup/README.

Path and environment variables:

None

Invoke:

% touchup

% touchup -n (to disable the "undo" feature)

Image display:

To load an image into Touchup, type the name of a Sun rasterfile in the Filename field which is located in the upper right-hand corner of the instruction panel area. Once the file name has been entered, move the cursor to the Load button and depress the left mouse button.

Exit:

Click the left mouse on the Quit button on the instruction panel.

5.18 Visilog

Purpose:

Visilog is a computer vision software package which provides both image processing and analysis capabilities. Analysis tools providing inertial parameters, shape measurements, pixel value readout, row/column profiles, and image extrema are available. A large library of morphological processing functions are offered as well as arithmetic, logic, and look-up table transformations, convolution with predefined or user defined kernels, graphic overlay of text or polygons, and the ability to create processing scripts or add in custom functions.

Developed by:

Noesis Vision Inc.
6800 Cote de Liesse, #200
St. Laurent, Quebec

Environment:

SunView

Restrictions:

Due to licensing restrictions, this software is only available on a single Sun workstation in the DVAL.

Image Format:

Visilog file format is the supported image format. Images in other formats may be imported. Image data may consist of byte, short, or long integer values.

Documentation:

The Visilog User's Manual is available in the DVAL.

Path and Environment Variables:

None

Invoke:

To invoke the package, enter the following commands from a shelltool:

% cd /swap.cll/visilog/new/v361/visilog/monitor

% ./visilog

Image Display:

To read a Visilog image file into one of the four Q buffers:

- Click on the <utilities> button in the function panel.
- Click on the <read> button.

VLOG : \$ read

Input : \$ VisilogFilename

Output : \$ Q3

To read a Sun rasterfile into one of the four Q buffers:

- Click on the <miscellaneous> button in the function panel.
- Click on the <import> button.

VLOG : \$ import

input file : \$ Sunfilename

size of header : \$ 32

Number of bytes per pixel : \$ 1

Y size of file : \$ 512

X size of file : \$ 512

File is swapped (no) : \$ 0

output image : \$ Q3

type (Char) : \$ 2

To display image:

- Click on the <display> button in the display panel and select the Q buffer to be displayed.

Exit:

Click the left mouse button on the exit button in the panel area.

5.19 XLoadImage

Purpose:

XLoadImage is a public domain package that displays images in an X11 window. Various viewing options are available with XLoadImage such as zooming, gamma correction, rotation, brightening, clipping, and dithering.

Developed by:

Jim Frost
jimf@saber.com

Environment:

X Window System

Restrictions:

None

Image format:

The following image types are currently supported and may be viewed with XLoadImage:

- CMU Window Manager raster files
- Faces Project images
- Fuzzy Bitmap (FBM) images
- GIF images
- G3 FAX images
- McIDAS areafiles
- MacPaint images
- Portable Bitmap (PBM) images
- Sun rasterfiles
- X pixmap files
- X10 bitmap files
- X11 bitmap files

Utah Raster Toolkit (RLE) files

Compressed files are automatically filtered through the uncompress command.

Documentation:

A man page is accessible by entering the command:

% man xloadimage

Path and environment variables:

The hidden file ~/.xloadimagerc defines the path and default extensions that are used when looking for images. Use of this file is described in the man page.

Invoke:

% xloadimage filename

Image display:

Discussed above.

Exit:

The window may be exited by typing q or ctrl-C with the cursor located in the window containing the image.

5.20 xv

Purpose:

Xv is an interactive image display and editing package. The capabilities of this package include and are not limited to: image display, stretching and compressing images, image rotation, flipping the image about the horizontal and vertical axes, cropping, magnifying, displaying pixel values and spatial information, gamma correction, colormap editing, dithering, smoothing, sharpening, and image conversion.

Developed by:

John Bradley
GRASP Lab, Room 312C
3401 Walnut St.
Philadelphia, PA 19104
Phone: (215) 898-8813
Email: bradley@cis.upenn.edu

Environment:

X Window System

Restrictions:

Software caveats are noted in the file `/usr/local/xv/README`. To view the contents of this file, enter the command:

```
% more /usr/local/xv/README
```

Image format:

The following image formats may be displayed: GIF, PBM, PGM, PPM, X11 bitmap, JPEG, Sun Rastefile, and PM formats on 1-, 4-, 6-, 8-, 16-, 24-, and 32-bit X displays. Xv will also read compressed versions of these files.

The following formats may be saved: GIF, PM, PBM (raw and ascii), X11 Bitmap, Sun rasterfile, PostScript, and JPEG.

Documentation:

To display the manual page for xv, the following command may be entered:

% man xv

Path and Environment Variables:

If running remotely under the X Window System, the DISPLAY environment variable should be set on the client as follows:

% setenv DISPLAY WorkstationName:0.0

Invoke:

% xv or % xv filename

Once the xv image window appears, the xv controls window may be displayed by clicking the right mouse button inside the xv image window. Alternatively, type the '?' key. If xv is invoked without a filename, a default image will appear in the xv image window.

Image display:

The Load button in the xv controls window may be used to load an image without specifying the filename on the command line. Depressing the left mouse button on the Load button displays the xv load window.

Exit:

The package may be exited from the Quit button in the xv controls window.

Appendix A: ON-LINE DOCUMENTATION FOR PACKAGES

PACKAGE

ALV

Image analysis tool

Eikonix camera tool

Dumpregion

Image enhancement tool

HIPS

NCSA Imagetool

Mathematica

Portable Bitmap Toolkit

Image registration tool

Raster Metafile Translator

Interactive reservation program

Tapetool

TECPLOT

Touchup

PV~WAVE

XLoadImage

xv

UNIX DOCUMENTATION

man alv

man blobtool

man camtool

man dumpregion

man enhancetool

man hips

man imagetool

man math

man pbmplus

man registertool

man rmtran

man signup

man tapetool

man tecplot

man touchup

man wave

man xloadimage

man xv

A manual page called packages is also maintained on the Sun network to provide an on-line overview of all packages resident on the system. This man page may be viewed by typing:

% man packages

Appendix B: AVAILABLE DOCUMENTATION

The following documents are available through the Operations Control Office (OCO, ext. 864-6562). Revision levels are current as of April 1992.

- (A-1e) INTRODUCTION TO THE CENTRAL SCIENTIFIC COMPUTING CENTER
- (A-6) LaRCNET User's Guide
- (CX-1e) CONVEX MINI MANUAL
- (CX-2a) CONVEX UNIX PRIMER
- (CX-50) CONVEX UNIX INTRODUCTORY Training Course
- (CX-78b) CONVEX OS TUTORIAL PAPERS
- (G-1a) GRAPHICS MINI MANUAL
- (G-14) RASTER METAFILE AND RASTER METAFILE TRANSLATOR

The following documents are available in the DVAL for reference only. They may not leave the lab.

- ALV Image Processing Toolkit for Sun Workstations
- Eikonix Model 1412 Digital Imaging Camera System Operator's Guide
- Eikonix Scanner Library - Reference Guide
- HIPS - Picture Processing Software
- Mathematica: User's Guide for Sun Workstations
- Matrix: How to use the Polaroid 8 x 10 Film Processor
- Matrix: User's Guide to the Model 6000 Color Graphic Recorder
- NCSA Imagetool for the Sun Workstation (Visualizing a set of data points)
- PV-Wave Image Processing Guide
- PV-Wave Introduction
- PV-Wave User's Guide
- Sun Mathematica - A System for Doing Mathematics by Computer: User's Guide
- Sun Microsystems Assembly Language Reference for Sun-2 and Sun-3
- Sun Microsystems Programmer's Guide
- Sun Microsystems Commands Reference Manual
- Sun Microsystems Debugging Tools
- Sun Microsystems Doing More with SunOS: Beginner's Guide

Sun Microsystems Editing Text Files
Sun Microsystems Floating Point Programmer's Guide
Sun Microsystems Fortran Programmer's Guide
Sun Microsystems Getting Started with SunOS: Beginner's Guide
Sun Microsystems Mail and Messages: Beginner's Guide
Sun Microsystems Network Programming
Sun Microsystems Pascal Programmer's Guide
Sun Microsystems Pixrect Reference Manual
Sun Microsystems Programming Utilities and Libraries
Sun Microsystems Self Help with Problems: Beginner's Guide
Sun Microsystems Setting Up Your SunOS Environment: Beginner's Guide
Sun Microsystems SunCGI Reference Manual
Sun Microsystems SunCore Reference Manual
Sun Microsystems Sun System Introduction: Beginner's Guide
Sun Microsystems SunView: Beginner's Guide
Sun Microsystems SunView 1 Programmers Guide
Sun Microsystems SunView 1 System Programmer's Guide
Sun Microsystems UNIX Interface Reference Manual
Sun Microsystems Using NROFF and TROFF
Sun Microsystems Using the Network: Beginner's Guide
Sun Microsystems Writing Device Drivers
TAAC-1 Application Accelerator Programming Course Notes
TAAC-1 Application Accelerator User Guide

Appendix C: IPSIG Special Interest Group Mail List

An image processing special interest group mail list (ipsig) is sponsored by the Data Visualization and Animation Laboratory (DVAL) of the Flight Software and Graphics Branch. The purpose is to disseminate and exchange information about image processing related topics of interest to the Langley community. Subjects can cover all image processing related issues, and are not restricted to topics concerning the DVAL.

DVAL will use the list to:

- announce equipment demonstrations
- announce new DVAL capabilities
- informally survey user requirements
- respond to user queries that may be of general interest

Subscribers may use the list to request or exchange information on hardware, software, algorithms, etc.

If you are interested in being added to this electronic mail list, mail your request (electronically) to:

ipsig-request@ipsun.larc.nasa.gov

Include an account which you use regularly -- timely access will benefit everyone. You will be sent a confirmation and some introductory information. This address may also be used for administrative details such as requesting removal from the list, and questions about the list. Only the ipsig administrator will receive mail sent to the ipsig-request@ipsun address.

Send your image processing questions and comments to:

ipsig@ipsun.larc.nasa.gov

Mail sent to ispig@ipsun will be broadcast to all list subscribers. Remember, you have to be on the list to receive mailings.

If you would like to speak to someone at DVAL, you can contact Kathy Stacy at ext. 46719.

Kathy Stacy
46719

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Table 1. Functionality and Characteristics of the Image Processing Packages in the Data Visualization and Animation Laboratory

	FUNCTIONALITY													CHARACTERISTICS			
	IMAGE ACQUISITION	IMAGE DISPLAY	IMAGE CONVERSION	IMAGE ANALYSIS	IMAGE DATA COMPRESSION	IMAGE EDITING	IMAGE ENHANCEMENT	IMAGE GRAPHICS OVERLAY	IMAGE ORIENTATION	IMAGE TRANSFORMS	MATHEMATICAL FUNCTIONS	NOISE TECHNIQUES	PLOTTING	VOLUME RENDERING	GRAPHICAL USER INTERFACE	MENU/COMMAND DRIVEN	PROGRAMMABLE
<div><div>* - Primary Functionality ✓ - Secondary Functionality S - SunView X - X Window System</div></div>																	
ALV		*	✓				*		✓						S	✓	
Blobtool		✓		*		✓									S		
Camtool	*	✓													S		
Dumpregion	*														S		
Enhancetool		✓		✓			*			*					S		
HIPS		✓	✓	*	*		*		✓	*		*	✓		S/X		
Mathematica		✓								✓	*		*		X	✓	✓
NCSA Imagetool		✓				✓	*		✓				✓		S		
PBMPlus			*													✓	
PV~WAVE		✓	✓	✓		✓	*	✓	✓	✓	*		*		S/X	✓	✓
Registertool		✓							*						S		
Rmtran			*			✓										✓	
TAAC		✓					*		✓	✓			✓	*	S		✓
Tapetool	*	✓													S		
Tecplot		✓						✓					*		S/X		
Touchup		✓				*		*	✓						S		
Visilog	*	✓		*		✓	*	✓	✓	✓			✓		S		✓
XLoadimage		*				✓	✓		✓						X		
xv		*	*			*	✓		✓						X		

* - Primary Functionality
 ✓ - Secondary Functionality
 S - SunView
 X - X Window System

Figure 1. DVAL Sun Network

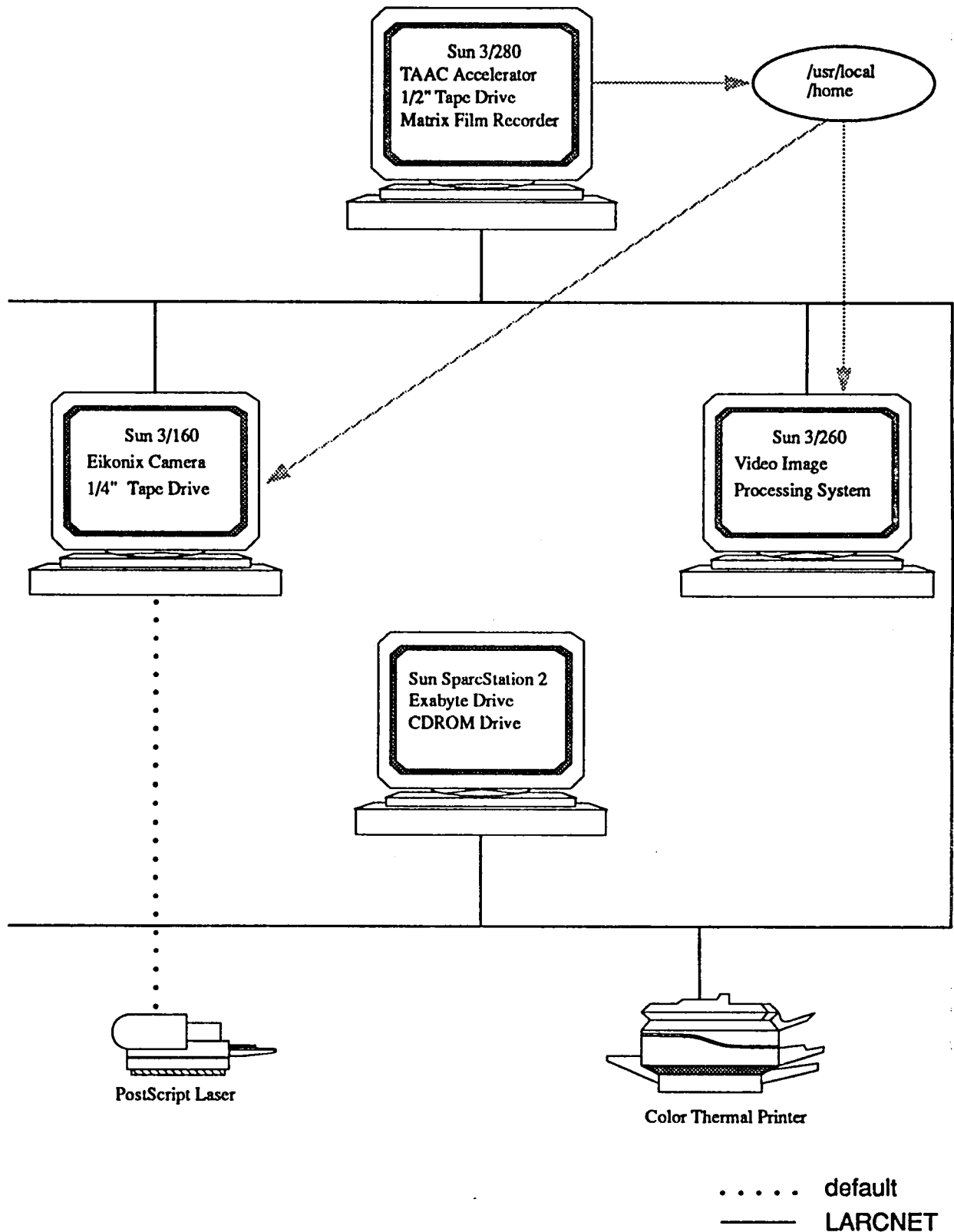


Figure 2. DVAL Silicon Graphics Network

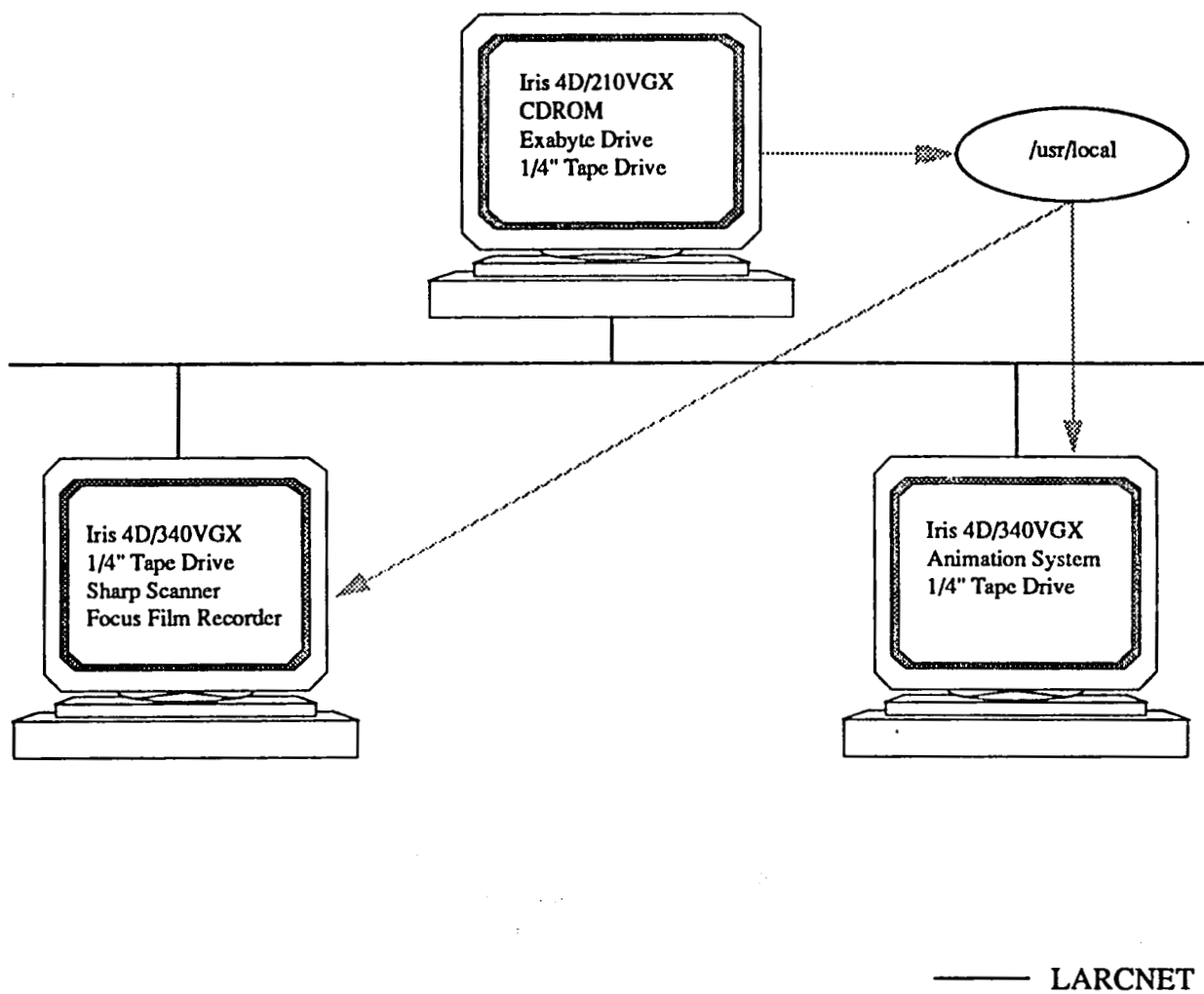


Figure 3. Sample Data Visualization and Animation Laboratory Account Request

Data Visualization and Animation Laboratory (DVAL)**ACCOUNT REQUEST FORM**

Each person working in the DVAL is required to have their own account. Check all that apply:

☐ ipsun/dagger/no1sun ☐ xvideo ☐ tempest ☐ tempi ☐ hojo*

Name: _____

Preferred login name (limited to 8 characters): _____

Telephone: _____

User affiliation (Check one):

☐ Full-time NASA employee
Directorate/Division/Branch _____

☐ Contractor
Company Name: _____
NASA Contact's Name: _____
NASA Contact's Directorate/Division/Branch _____

☐ CO-OP, ASEE, LARRS, other
NASA Contact's Name: _____
NASA Contact's Directorate/Division/Branch _____
Date of departure: _____

Permanent EMAIL address (outside of DVAL): _____

NASA mail stop: _____

Date of request: _____

FSGB staff member signature*: _____

STATEMENT OF USER POLICY

All accounts will be reviewed in February of each year. If your account has been inactive for more than 12 months and you can not be reached, FSGB reserves the right to **DELETE** your account and files. If you wish to retain your account or its files and will be unavailable for longer than one year, plan to make special provisions with an FSGB staff member.

User Signature

*Request for an account on hojo requires approval/signature of John T. Bowen - MS 125A
(over)

Figure 3a. Sample Data Visualization and Animation Laboratory Account Request

Project title: _____

Project description: _____

Description of data (include format or type): _____

May we use your data in the future for demonstrations? (initial one) ☐ Yes ☐ No

If experimentally acquired data, which facility? _____

Goals: _____

What software package(s) will you be using?

☐ ALV ☐ FAST ☐ PLOT3D ☐ PV~WAVE

☐ TECPLOT ☐ VISILOG ☐ WAVEFRONT ☐ OTHER _____

What are your requirements for output?

☐ Film hardcopy ☐ Production quality video ☐ Black & White PostScript

☐ Statistical data ☐ Thermal wax transfer ☐ ACD Production devices

☐ Video prints ☐ OTHER _____

How did you hear about the Data Visualization and Animation Laboratory? _____

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 1992		3. REPORT TYPE AND DATES COVERED Technical Memorandum
4. TITLE AND SUBTITLE Image Processing Mini Manual			5. FUNDING NUMBERS WU 505-90-53-02	
6. AUTHOR(S) Christine G. Matthews, Mary-Anne Posenau, Desiree M. Leonard, Elizabeth L. Avis, Kelly R. Debure, Kathryn Stacy, and Bill von Offenheim				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NASA Langley Research Center Hampton, VA 23665-5225			8. PERFORMING ORGANIZATION REPORT NUMBER CSCC Doc. A-9	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001			10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA TM-107680	
11. SUPPLEMENTARY NOTES Matthews, Leonard, Avis and Debure: Computer Sciences Corporation, Hampton, Virginia. Posenau, Stacy, and von Offenheim: Langley Research Center, Hampton, Virginia.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified - Unlimited Subject Category - 60			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The intent of this report is to provide an introduction to the image processing capabilities available at the Center. More specifically, the manual identifies and describes various image processing software components and provides information concerning the use of these components in the Data Visualization and Animation Laboratory at LaRC.				
14. SUBJECT TERMS Image Processing Software			15. NUMBER OF PAGES 78	
			16. PRICE CODE A05	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT	